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See Nothing is a piece for string quintet (two violins, viola, cello, double bass), and electronics. The electronic component is a 'tape track' that uses pre-recorded string pitches tuned to the frequencies of a single harmonic series. The performers use the tape track as a live tuning device to allow for the accurate reproduction of pitches based on harmonic series overtones. *See Nothing* follows a long historical precedent of Western music that uses the harmonic series as a foundational resource. This thesis discusses two of the most canonized musical ideas that use the harmonic series: just intonation and spectralism. It also compares some of the musical components of *See Nothing* to works by James Tenney, Georg Friedrich Haas, and Michael Harrison. The thesis describes the formal, harmonic, and timbral features of *See Nothing*, as well as reflecting on some of the more and less successful practicalities of using the tape track as a method for accurate live tuning.

SEE NOTHING: FOR STRING QUINTET AND ELECTRONICS

by

Treya Michelle Nash

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CHAPTER I

INTRODUCTION

Experimentation with tuning was commonplace in Western musical practice until twelve-tone equal temperament began to gain traction between the mid-eighteenth-century and early nineteenth-century, eventually becoming standard tuning practice.[1] While arguments surrounding correct tuning practice subsided, intonational exploration continued into the twentieth century under various guises. The harmonic series is often at the center of tuning practice. One tuning system strictly based on the harmonic series is just intonation. Just intonation uses interval ratios from the harmonic series as a tuning method. This premise appears in the work of ancient Greek philosopher Pythagoras, who built a scale based on the interval ratios 2/1 and 3/2, an octave and a perfect fifth.[2] These small-number ratios represent the most consonant intervals in the harmonic series, and the foundation of tonal harmony. Greek philosopher Ptolemy developed a major scale using the overtone relationships of the harmonic series, as well as their inversions.[3] Key figures in the history of just intonation include Renaissance composer and theorist Gioseffo Zarlino (1517–1590), a champion of Ptolemy's just tuning system in vocal

[1] *Grove Music Online*, s.v. "Temperaments," accessed March 15, 2020, https://doi-org.libproxy.uncg.edu/10.1093/gmo/9781561592630.article.27643.
[2] Bob Gilmore, introduction to *Maximum Clarity and Other Writings on Music* by Ben Johnston, ed. Bob Gilmore (Illinois: University of Illinois Press, 2006), xviii.
[3] Kyle Gann, "Just Intonation Explained," Kyle Gann, accessed March 2, 2020, https://www.kylegann.com/tuning.html.

music during a time when arguments surrounding intonation were rife.[4] Particularly influential, German physician Herman von Helmholtz's (1821–1894) book *On the Sensations of Tone as a Physiological Basis for the Theory of Music* "provided a classic analysis of the role of overtones," as well as describing the phenomenon of beating as a physical sensation.[5]

In the early twentieth century, composer Harry Partch (1901–1974) led a resurgence of interest in just intonation. Partch became interested in just intonation after reading *On the Sensations of Tone*. In his text, *Genesis of a Music*, he argued for the inclusion of the eleventh partial as a basis for interval relationships in just intonation, which had previously largely been limited to the fifth partial, as per Ptolemy's scale.[6] In order to correctly produce his scales in practice, Partch built his own just-tuned instruments.[7] The theory put forward in *Genesis of a Music* became highly influential to Partch's students, their own students, and various contemporaries interested in just intonation tuning practices.

Twentieth and twenty-first century composers who use just intonation have widely varying styles and methodologies. Students of Partch such as Lou Harrison (1917–2003) and Ben Johnston (1926–2019), and Johnston's student Kyle Gann (b. 1955), tend to use just intonation to create new functionalities of harmony within a more

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[4] David P. Goldman, "A New Look at Zarlino's Theory and its Effect on his Counterpoint Doctrine," *Theory and Practice* 16 (1991): 164.
[5] *Grove Music Online,* s.v. "Physics of Music."
[6] Harry Partch, *Genesis of a Music*, 2nd ed., (New York: Da Capo Press, 1974), 90–91.
[7] Kyle Gann, *The Arithmetic of Listening: Tuning Theory and History for the Impractical Musician* (Urbana: University of Illinois Press, 2019), 137.

traditional structure of melodic development. Other American composers such as James Tenney (1934–2006) and La Monte Young (b. 1935) tend to eschew traditional melodic structures, alleviating the need to build scales.[8] Condensing the register of overtones into the space of an octave and use of the subharmonic series are representative features often present in systems of just intonation that differ from other canonized uses of the harmonic series in western classical music, such as spectralism.[9]

While just intonation is a set of principles that use the harmonic series to guide many tuning systems, spectralism is a term used to describe a movement that began with the analysis of harmonic series spectra, more concerned with the afforded interactions between harmony and timbre than the mathematical accuracy of tuning. The term "spectralism," is widely-used, often without a clear definition, and contested by some of its commonly named practitioners.[10] I use the term to describe the aesthetic movement initiated by a group of composers who comprised Ensemble L'Itinéraire in 1973 Paris, which included Gérard Grisey (1948–1988), Tristan Murail (b. 1947), Michaël Levinas (b. 1949), Roger Tessair (b. 1939), and Hughes Dufort (1943).[11]

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[8] Ben Johnston, *Maximum Clarity and Other Writings on Music,* ed. Bob Gilmore (Illinois: University of Illinois Press, 2006), 43–44.

[9] The subharmonic series, or undertone series, is the inverted harmonic, or overtone series. In the subharmonic series, the ratio 3/4 becomes 4/3, for example. Unlike the harmonic series, the subharmonic series does not occur naturally.

[10] Julian Anderson, "A Provisional History of Spectral Music," *Contemporary Music Review* 19, no. 2 (2000): 7–8.

[11] Jonathan Cross, "Introduction: Spectral Thinking," *Twentieth-Century Music* 15, no. 1 (February 2018): 6–7.

Robert Hasegawa discusses how each composer has their own definition and description of spectralism.[12] Hasegawa summarizes:

> As a generalisation we could say that the essential characteristic of spectralism is the dissection of sounds into collections of partials or overtones as a major compositional and conceptual device. Spectral composers use the acoustical fingerprints of sounds – their spectra – as basic musical material.[13]

A more specific definition of the 1970s French spectralist movement refers to it as "mimetic spectralism […]. The actual harmonic spectrum of a chosen timbre is orchestrated and transformed through electronic-like processes (additive synthesis, ring modulation, etc.)."[14] Another aspect of spectralism often discussed is the subversion of traditional use of time in music. In one of Grisey's articles, he argues:

> From its beginnings, this music has been characterized by the hypnotic power of slowness and by a virtual obsession with continuity, thresholds, transience and dynamic forms. It is in radical opposition to all sorts of formalism which refuse to include time and entropy as the actual foundation of all musical dimensions.[15]

Spectralism has a strong precedent in the work of composers such as Edgard Varèse (1883–1965), Giancinto Scelsi (1905–1988), Karlheinz Stockhausen (1928–2007), and György Ligeti (1923–2006), especially in terms of treating timbre and time as

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[12] Robert Hasegawa, "Gérard Grisey and the 'Nature' of Harmony," *Music Analysis* 28, no. 2 (July–October 2009): 349.
[13] Ibid.
[14] Livia Teodorescu-Ciocanea, "Timbre versus Spectralism," *Contemporary Music Review*, 22, no. 1 (2003): 89.
[15] Gérard Grisey, "Did You Say Spectral?" trans., Joshua Fineberg, *Contemporary Music Review* 19, no. 3 (2000), 2.

principal musical elements.[16] Despite the harmonic series being the of spectralism being, microtonality is not always a feature of spectral music.[17] Tristan Murail describes spectralism as "chiefly an attitude towards musical and sonic phenomena, although it also entails a few techniques, of course."[18] I offer these definitions of spectralism as summaries of some of the important features of the music of the 1970s French composers that continue to be used by composers who identify with the movement. I present spectralism as an avenue of musical thought and exploration that began with analysis of the harmonic series, and evolved to cover a wide span of timbral and temporal issues. I assert that it is up to individual composers to argue for or against the term in relation to their music, given the range of ideas the term seems to cover.

Spectralism and just intonation are two of the most canonized uses of the harmonic series in Western classical music, but many approaches fall outside these categorizations. Austrian composer Georg Friedrich Haas (b. 1953), often called a spectralist, says "I do not feel myself as a 'spectral composer.' I use some chords, which have relationships to the harmonic series. I use them because I love them and because they sound great. But I never used spectral analyses."[19] Haas often uses the harmonic series in his work, but also experiments with other systems of microtonal tuning. Haas supports James Tenney's focus on the acoustic properties of the harmonic series, and its

[16] Johnathan Goldman, "Boulez and the Spectralists between Descartes and Rameau: Who Said What about Whom?" *Perspectives of New Music* 48, no. 2 (Summer 2010): 213.
[17] Hamilton, Andy, "Spectral Composition," accessed February 10, 2020, https://www.dur.ac.uk/philosophy/staff/?mode=pdetail&id=512&sid=512&pdetail=47590.
[18] Tristan Murail, interviewed by Ronald Bruce Smith, "An Interview with Tristan Murail," *Computer Music Journal* 24, no. 1 (Spring 2000): 11.
[19] Sam Riesling, "5 Questions to George Friedrich Haas (Composer)," *I Care if You Listen*, Tuesday November 19, https://www.icareifyoulisten.com/2013/11/5-questions-to-georg-friedrich-haas-composer/.

influence on the perception of the listener.[20] Tenney often uses just intonation practices, such as undertone-series intervals and mixing registers of partials, to create music that is sometimes referred to as spectral. American composer Michael Harrison (b. 1958) writes piano music that uses just-intoned scales and traditional melodic structure, but also writes pieces that use pitches based on overtones in their original register. Presenting overtones in their original register results in the consistent structure of the overtone series as it appears naturally. Moving overtones between registers obscures this familiar structure and weakens the influence of the fundamental, while allowing for much more flexibility in range and harmonic function.

The next chapter will detail features of specific works by Tenney, Haas, and Harrison that share commonality with my piece, *See Nothing*. The work of these three composers illustrates that the categorization of music into historical or theoretical principals can often be imprecise. It makes more sense to me to categorize current music in terms of the features of different traditions and styles that it may relate to.

See Nothing, for string quintet and tape, reflects my interest in spectralism through the use of overtones in their original position, and timbral exploration. The piece reflects my interest in just intonation through an attempt to tune to the harmonic series as closely as possible, and the organization of harmony into distinct chords. The fixed media, or 'tape' component of *See Nothing* functions as a method of diversifying timbre,

[20] Georg Friedrich Haas, interviewed by Vincent Ho, "Ultimate Maverick, Georg Friedrich Haas Interview with Vincent Ho," YouTube video, 38:13, posted by Ludwig Van, February 7, 2015.

and acts a reference for accurate live tuning for the performers. This allows for a large number of partials from a single harmonic series to be expressed and explored.

CHAPTER II

PRECEDENTS FOR *SEE NOTHING*

See Nothing shares some commonality with James Tenney's *Arbor Vitae* (2006) for string quartet, Georg Friedrich Haas' *Open Spaces II* (2007) for twelve strings and two percussionists, and Michael Harrison's *Cello Constellations* (2018) for solo cello and pre-recorded electronics. The principal similarity between these four pieces is the use of the harmonic series as a basis for their tuning systems. They also share some similar methodologies, though the shaping and treatment of sound diverges in all four pieces. The variance possible between four pieces that use a common harmonic framework demonstrates the possibility of creating individualized sound worlds using harmonic-series-based tunings.

While *See Nothing* uses a single fundamental as a harmonic framework, the resultant pitches are organized into chords based on various mathematical properties. This is similar to James Tenney's organization of harmony in Arbor Vitae. James Tenney uses a single fundamental, B-flat1, whose partials are divided into subsets of harmony, each based on Tenney's mathematical framework of "roots."[21] In Michael Winter's analysis of *Arbor Vitae*, Winter describes how "the sounding pitch classes are derived from harmonics of successively chosen roots, called 'branches'— that is, pitches are

[21] Michael Winter, "On James Tenney's Arbor Vitae for String Quartet," *Contemporary Music Review* 27, no. 1 (February 2008): 133.

derived from harmonics of harmonics. Thus, every pitch in the piece is harmonically related to B-flat."[22] Eventually, pitches emerge from all of the "branches," in conjunction, revealing their relationship to the B-flat fundamental.[23] Though the lowest string of the cello is tuned to B-flat1 to allow for the production of natural harmonics, the pitch B-flat1 is never played. This creates a kind of imaginary fundamental, implied but never actually heard. The fundamental of *See Nothing*, C0, is similarly implied but never heard. One feature of *Arbor Vitae* that differs significantly from *See Nothing* and the other pieces discussed in this chapter is Tenney's displacement of pitches between ranges. Figure 1 shows a section of *Arbor Vitae* where Tenney uses a C-sharp4 in the cello part, the tuning of which is derived from the ratio 75/64.[24]

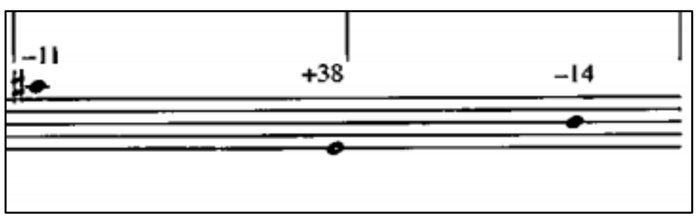

Figure 1. James Tenney, *Arbor Vitae*, 9'15"-9'20".[25]

As the 75th partial of B-flat1, this pitch would occur between C8 and C-sharp8 as an overtone. This compression of register obscures the familiar intervallic relationships of the harmonic series, destabilizing the overriding influence of the fundamental.

[22] Winter, "James Tenney's Arbor Vitae," 133.
[23] Ibid.
[24] Ibid., 138.
[25] James Tenney, *Arbor Vitae* (Lebanon NH: Frog Peak Music, 2006), 14.

Georg Friedrich Haas' piece *Open Spaces II* uses the fundamental C1, and a second fundamental pitched a sixth-tone below C1. Haas uses scordatura tuning for the twelve string instruments, which gives him a wide range of pitches to choose from, and helps with tuning accuracy. Six of the string instruments are tuned to the overtones of C1, while the other six are tuned a sixth-tone below.[26] Haas juxtaposes both harmonic series to create a "shadow," effect.[27] Haas also instructs the players of the lower harmonic series to stop their strings at the top of the fingerboard, allowing them to tune to the C1 harmonic series. This method allows Haas to explore the timbral contrast of open and stopped strings.[28] *See Nothing* also contrasts open and stopped strings as a means of allowing for natural harmonics and diversifying timbre. While *Arbor Vitae* is continuous in rhythm, density, and timbre, *Open Spaces II* has moments of dramatic contrast that arise from the form of the piece, seven distinct sections that each explore a different timbral effect. *See Nothing* also follows a more traditional conception of tension, sectionalism, and contrast within the static harmonic context. I used some elements of Haas' system of accidentals, which do not show cents deviation, but indicate relative deviation from equal temperament.

Michael Harrison's piece *Cello Constellations* uses pre-recorded cello sounds and sine tones in conjunction with a cello soloist. The live cello part consists largely of sustained pitches that change against a constant framework of two fundamentals and their

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[26] "Georg Friedrich Haas: Open Spaces," Universal Edition, accessed February 22, 2020, https://www.universaledition.com/georg-friedrich-haas-278/works/open-spaces-12865.
[27] Haas, "Open Spaces."
[28] Ibid.

overtones. Harrison's use of the harmonic series is audibly clear. He emphasizes his first fundamental, C2, by introducing a drone on C2 that continues throughout the first section of the piece. Given the relatively stable fundamental(s) of the piece, the live performer is responsible for playing accurately tuned pitches, which include a combination of harmonics and stopped pitches. Within this framework of stable fundamentals, Harrison manufactures acoustic beating through use of close partials based on other, unheard fundamentals. Roughly eleven minutes into the sixteen-minute piece, Harrison moves from the C2 fundamental to a D2 fundamental, creating a kind of dramatic transposition which highlights the structure of the harmonic series.[29] *See Nothing* uses a similar combination of tape track built from string sounds, though without the addition of sine tones. *See Nothing,* like *Cello Constellations*, features a prevalent drone. This C1 drone, an octave above the fundamental, acts as a substitute for the true fundamental, and creates a sonic anchor that provides constant harmonic context to the higher partials.

Discussion of these four pieces demonstrates that techniques used in *See Nothing* have precedents in other works that utilize the harmonic series. Despite this, each of these four works treat harmonic material through different structural, timbral, and mathematical procedures. The possibilities for exploration of harmonic-series tunings are vast, with plenty of room for further investigation.

[29] The score for *Cello Constellations* is not yet available; my analysis is based on a recorded version of the piece on Harrison's *soundcloud,* https://soundcloud.com/michael-harrison-piano/cello-constellations.

CHAPTER III

PROCEDURES USED IN *SEE NOTHING*

As well as the examples discussed in the previous chapter, *See Nothing* takes precedence from my previous work. In an earlier piece for string quintet, *Plot Device* (2019), I explored a method of live-tuning involving the four higher instruments matching their pitches to natural double bass harmonics, emphasizing the different fundamentals of the four bass strings. While I found this system to be an effective method of accurate live-tuning, I wanted to explore a wider range of partials than those afforded by the bass string harmonics. This gave me the idea for the system of live instruments with fixed media that I used for *See Nothing*.

The live instruments tune to the tape track in order to produce pitches based on the partials of the harmonic series. I chose the 'imaginary fundamental' C0 because a lower fundamental means that closer overtones can be used in a lower register. Like Michael Harrison, I tuned my pitches to frequencies, rather than using ratios to derive cents deviation from equal temperament. I multiplied the frequency of C0 (16.35hz, C0 in relation to A440) by each partial number to produce their respective frequencies, from which I generated sine tones. I recorded string players playing pitches tuned to these sine tones, up to the sixty-fourth partial of C0. I used these recorded pitches to construct a tape track that I could use both as a tuning system, and to further the musical dimensions of density and timbre. I used accidentals to show the relative distance of pitches to their equal tempered counterparts. Figure 2 shows the accidentals and their meanings.

Symbol	Meaning
♭ ♮ ♯	Very close to the equal tempered pitch; either exactly the same or with a very slight difference.
-♭ -♮ -♯	Slightly but noticeably flatter than the equal tempered pitch.
♭↓ ♯↓ ♮↓	Significantly flatter than the equal tempered pitch.
+♭ +♮	Slightly but noticeably sharper than the equal tempered pitch
♭↑ ♮↑ ♯↑	Significantly sharper than the equal tempered pitch

Figure 2. Accidentals used in *See Nothing*.

Accidentals are especially important when the live performers have to match pitch to the tape track. These accidentals are designed to help performers find the correct pitch efficiently. The lack of precise mathematical definitions of accidentals is intended as a method of encouraging the performers to tune aurally to the tape track rather than trying to calculate exact relationships to equal temperament.

Figure 3 shows the procedure by which the live instruments tune to the tape track. In m. 10, the cellist hears the lowered B4 in the tape for a beat. The cellist begins to match this pitch, blending into, then eclipsing the tape. Once the cellist has established their pitch, they *decrescendo* to *pianissimo* in order to allow the violist to find their pitch in m. 12.

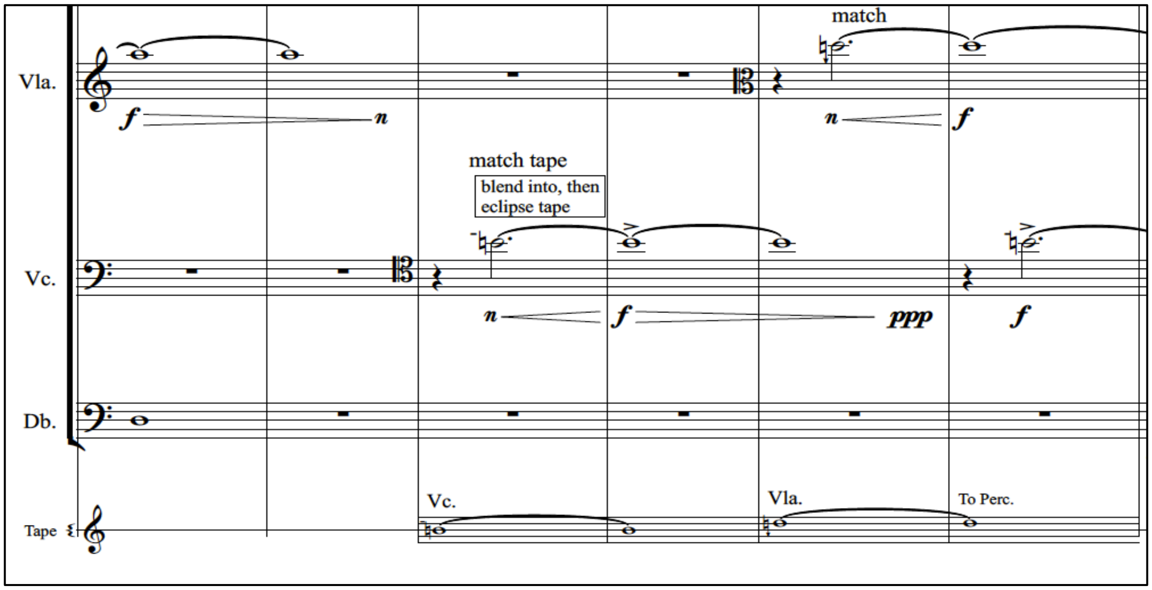

Figure 3. *See Nothing*, mm. 8–13, Viola, Cello, Double Bass, and Tape Parts.

This pattern of establishing a pitch, then decreasing in volume, occurs throughout the piece. Often, performers continue to play their established pitch quietly while others are still finding theirs, creating a background of shifting density and harmony against the foreground activity. This helps to create dimensionality within the piece. Pitch matching allows the performers to produce accurately tuned stopped pitches. In order for performers to be able to play on open strings, I calculated scordatura tunings so that most open strings represent overtones of C0. This allows for the use of natural harmonics which fit into the C0 harmonic series. Figure 4 shows the scordatura tunings for the piece. The numbers above the pitches indicate the partial that they represent in relation to C0 (note that the double bass pitches are written an octave above their sounding pitch, as per standard practice).

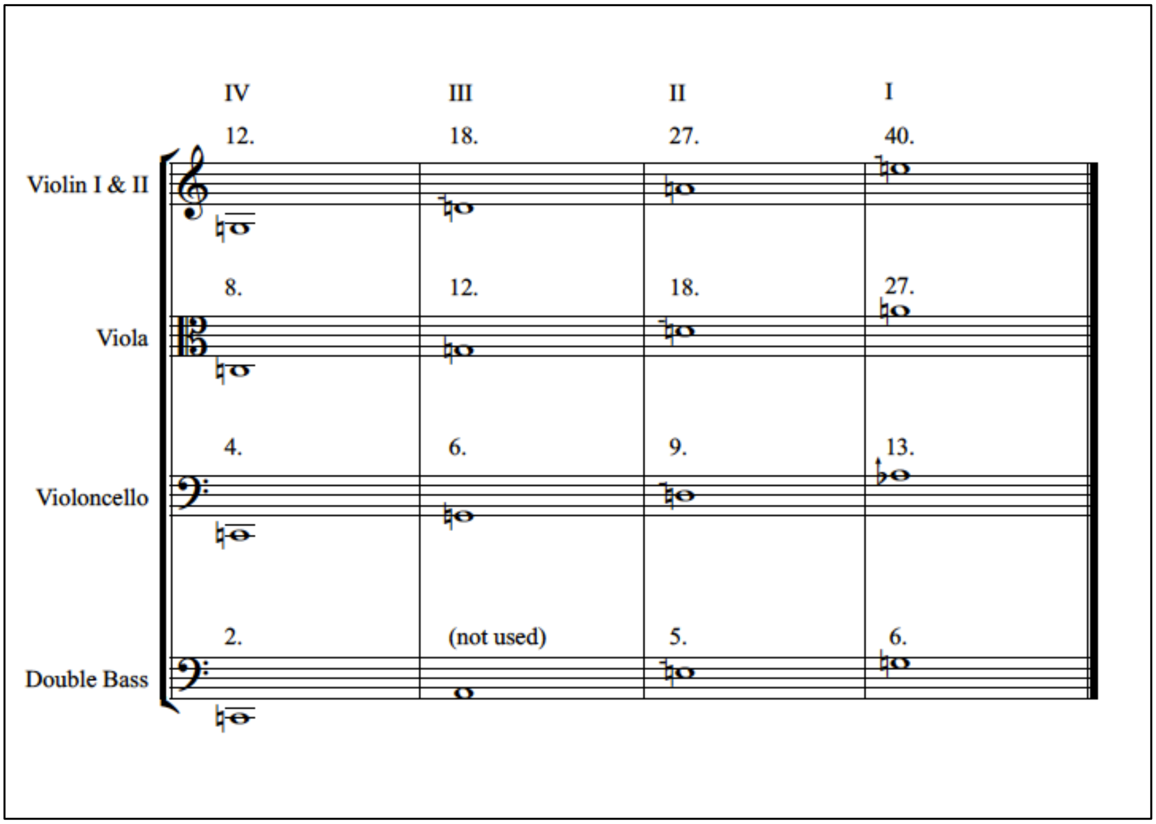

Figure 4. Scordatura Tunings for Each Instrument.

Sound files for players to tune the strings to are provided, ensuring that the players use the same tuning as the tape track. Any time an open string or harmonic should be played, the number of the string appears above the pitch. Pitches without a string number are always stopped pitches. The choice of scordatura tuning is generally the closest available overtone of the C0 harmonic series, so that strings do not have to be drastically de-tuned. The issue of performers finding the correct pitch on re-tuned strings is mitigated by the small number of distinct pitches that each performer has to match throughout the piece, at most seven. During the process of writing the piece, I tested this feature with two string players, and found that they were both extremely capable of matching tape pitches on the de-tuned strings.

This tuning system allows performers to tune accurately to a wide range of pitches without having to memorize them, or use electronic tuners. Due to the rate of change of pitches in the piece, metrical accuracy is extremely important. For this reason, the piece requires a conductor who listens to a click track which is provided with the tuning guide. This metrical limitation is one area on which I would like to improve when using this method of live tuning in further work.

As well as the practical tuning aspect of using the tape track, the track complements the live performers by adding another timbral dimension to the piece. The following chapter on form, harmony, and timbre explores the ways in which I used the tuning system to create the piece.

CHAPTER IV

FORM, HARMONY, AND TIMBRE

See Nothing has three sections, A, B, and A’, mapped in Figure 5.

Section	A	B	A’
Time	0’00”--------------------------------	6’24”-----------------	9’36”-------12’34”
Measure	mm. 1–96	mm. 97–14.	mm. 145–188

Figure 5. Basic Form of *See Nothing.*

In this chapter, I will describe how the harmonic and timbral trajectory of the piece shapes its structure. The use of a single harmonic series creates an overarching static harmony, but the division of the harmonic series into four distinct chords creates internal harmonic development. The chords are formed from various open strings and stopped pitches between the second and sixty-fourth partial (the range of pitches that I recorded), with some natural harmonics that extend beyond this range. Moments when various configurations of the chords are expressed clearly through unity of rhythm and dynamics are known as ‘arrival points.’ In addition to harmony, arrival points are characterized by their timbre and relative density. Transitionary sections between the eight arrival points allow the live instruments to find their pitches and emphasize various intervallic and rhythmic structures. The arrival points act as cadence points in the piece through their release of built-up tension and structural prominence.

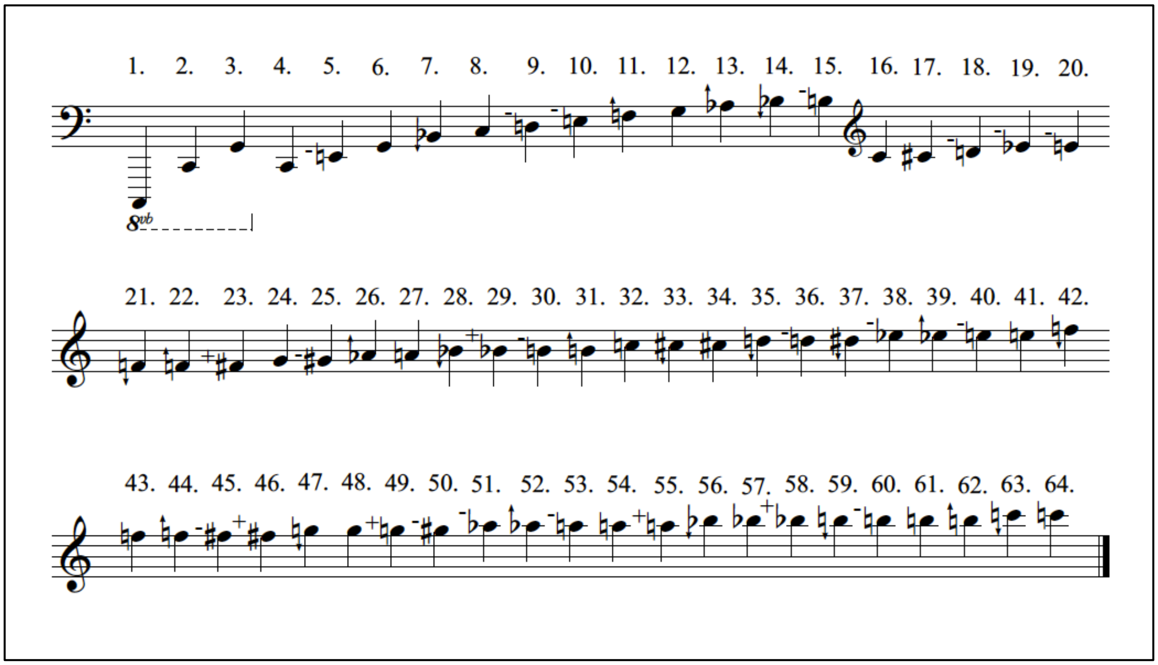

Figure 6. The Harmonic Series Based on C0, up to the Sixty-Fourth Partial.

The four chords of the piece, which are labelled A, B, C, and D, are comprised of various mathematical configurations of pitches of the harmonic series. The chords are labelled in terms of the order in which they appear in the piece. Chords A, B, and D are based on the multiples of partials seven, five, and three respectively. The resultant chords have the same intervallic relationships as the original harmonic series. The similarity in intervallic organization gives these chords a connection to one another and to the original series. I used pitches that occur in more than one of these chords to ‘modulate’ between them. Figures 7, 8, and 9 show the possible pitches of these three chords. The numbers above the pitches show their position as partials in the C0 series.

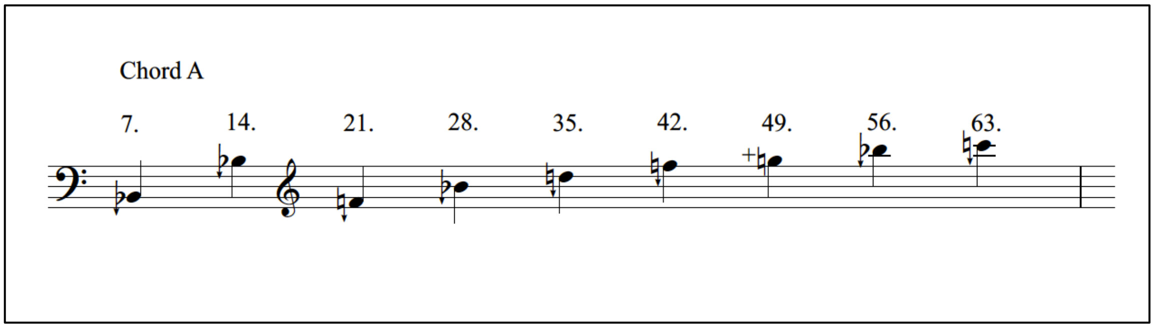

Figure 7. Possible Pitches in Chord A, Based on Partial 7 of C0.

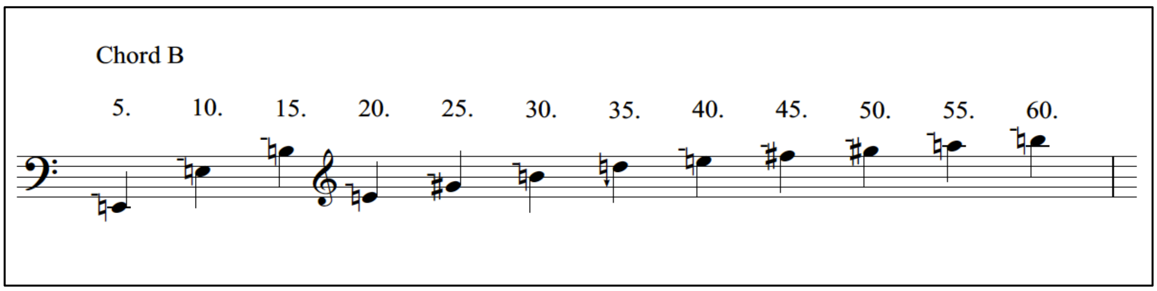

Figure 8. Possible Pitches in Chord B, Based on Partial 5 of C0.

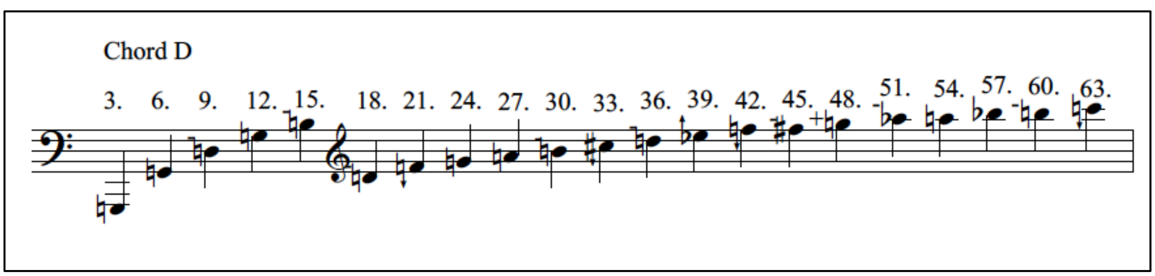

Figure 9. Possible Pitches in Chord D, Based on Partial 3 of C0.

The relationship between the A and A’ sections is defined by the use of Chords A and B throughout the A section, and Chord D, and Chord A in the A’ section. Though these chords have varying numbers of possible pitches, their common intervallic configurations (octave, fifth, fourth, et cetera) give them structural sonic similarity.

Chord C uses the prime partials of the C0 harmonic series. These partials are unique, because their only factors are 1 and themselves, meaning that there are no octave relationships between these pitches; each pitch is unique and occurs for the first time in the position shown in Figure 10. Chord C appears in the B section of the piece.

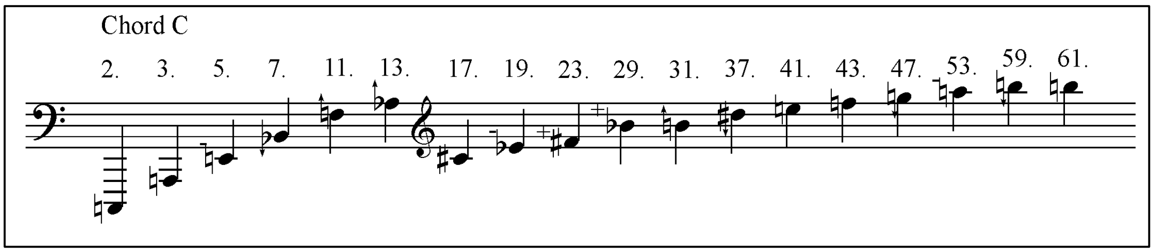

Figure 10. Possible Pitches in Chord C, Based on the Prime Partials of C0.

Figure 11. Map of the Form of *See Nothing*.

The map of the form shown in Figure 11 includes the pitches in each chord at each arrival point, and divides them by their appearance in the tape track or live instruments. This demonstrates the trajectory of shifting density in the piece. The density of harmony interacts with the timbral shifts between arrival points, due to the contrast of recorded, processed sound and live instruments.

The construction of timbre at each arrival point is a feature designed to shape the harmonic palette of the overtone series. Each arrival point acts as a convergence of harmony, but their different treatment creates moments of lesser and greater tension within the piece. The point of greatest density, arrival point six, occurs at the end of the B section. This arrival point contains eleven tape pitches. The pitches are spaced between the tape and live instruments, to create a blend in register that creates a homogenous block of sound in which individual pitches are largely obscured. Figure 12 shows the beginning of the gradual build-up to this chord, which allows for the pitches of Chord C to sound before they begin to lose their independence. The tape pitches begin in the low register, allowing space for the two violins to find their pitches in m. 129 and m. 131.

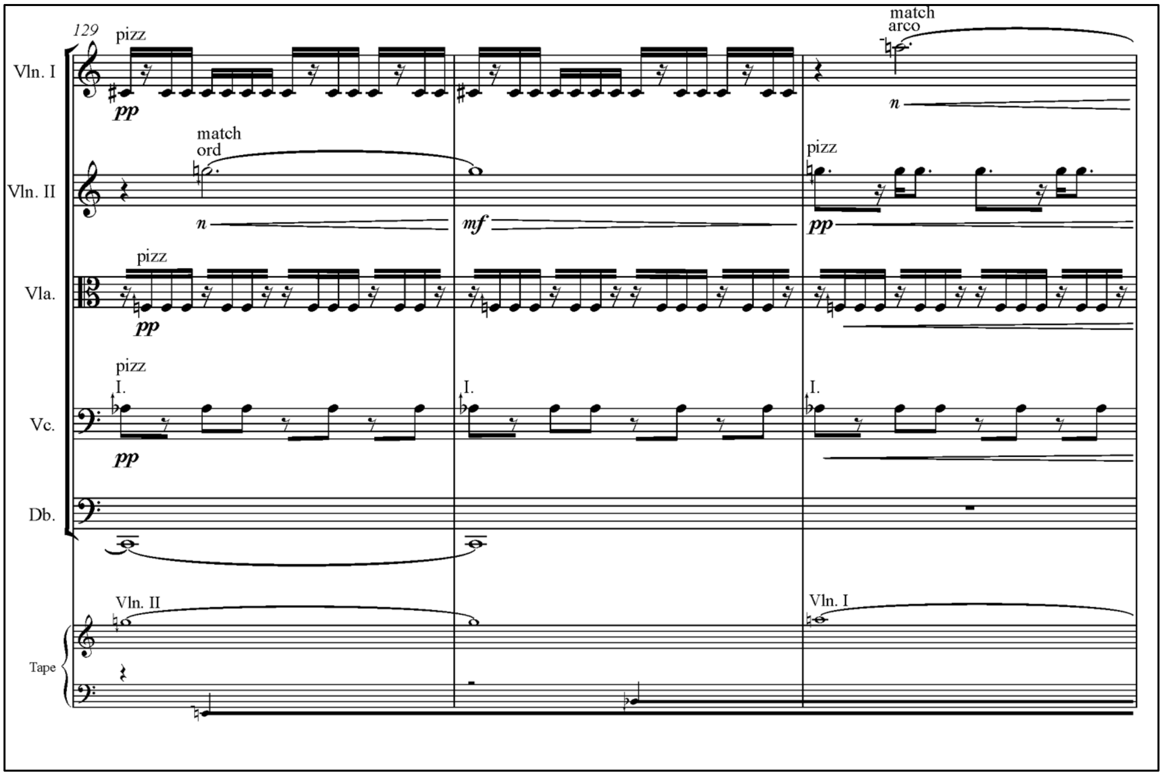

Figure 12. *See Nothing,* mm. 129–131.

Underneath the violin pitches, drones begin to enter in the tape part, first on the second beat of m. 129, and then on the third beat of m. 130. The pizzicato texture in the live strings continues over the incrementally thickening texture of the tape part until arrival point 6, which is shown in Figure 13.

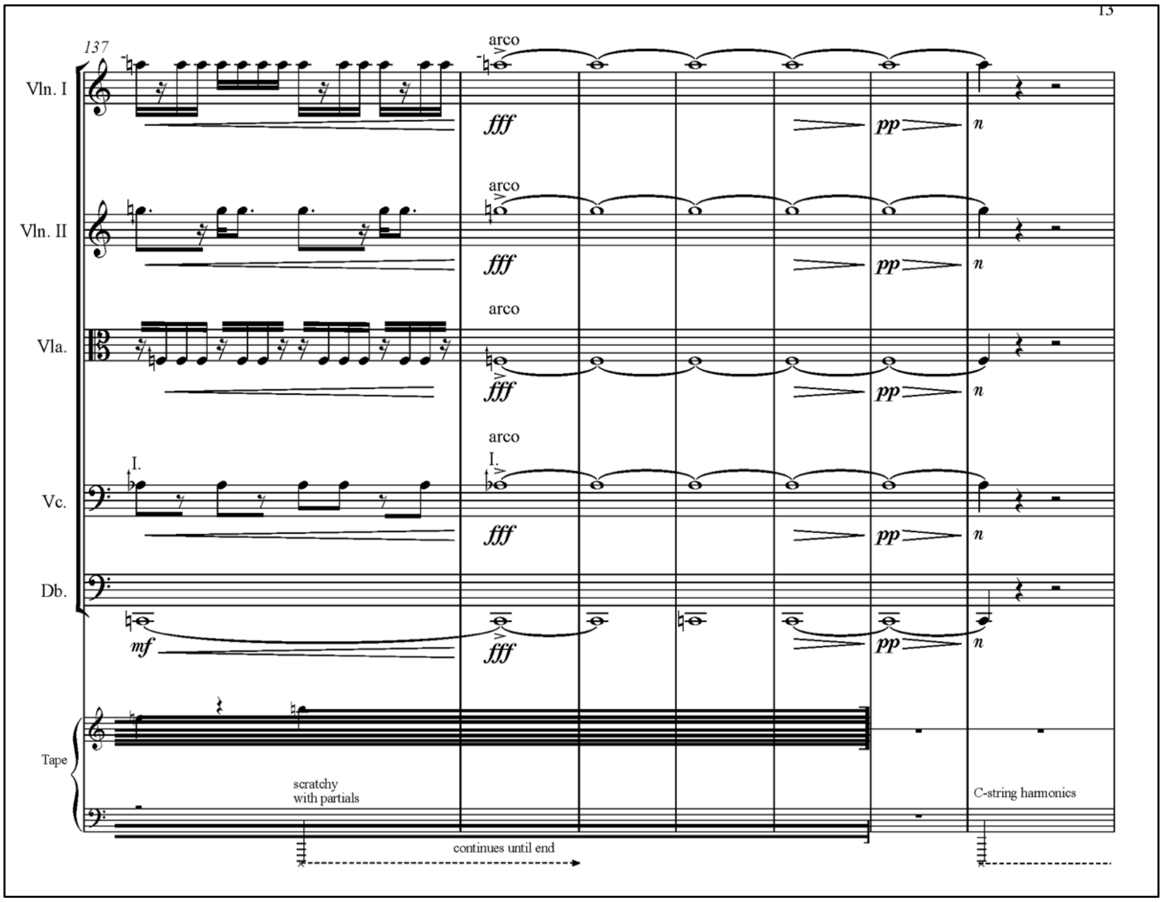

Figure 13. *See Nothing*, mm. 137–143.

In m. 138, the violins, viola, and cello *crescendo* on sustained, *arco* pitches, creating a sudden increase in density, which has, up until this point, been increasing bar-by-bar. The sudden switch from *pizzicato* to *arco* in the live instruments creates a moment of sudden timbral shift. At m. 142, the tape part drops out, leaving the five live strings playing Chord C pitches, an opportunity to once again hear the harmony clearly. This iteration of the chord is *pianissimo*, a further contrast which shapes the end of the arrival point.

The arrival points in the A’ section of the piece present a stark timbral contrast to the harmonically dense B section, through use of open strings and harmonics. The scordatura tunings (see Figure 4) mean that most of the open strings fit into Chord D. The possibility for chords comprised of only natural harmonics introduces a new timbral range for the final section. Internal timbral contrast is created in the A’ section through the development from stopped pitches, to open strings, to natural harmonics. Figure 14 shows arrival point 7, which moves between stopped pitches and open strings.

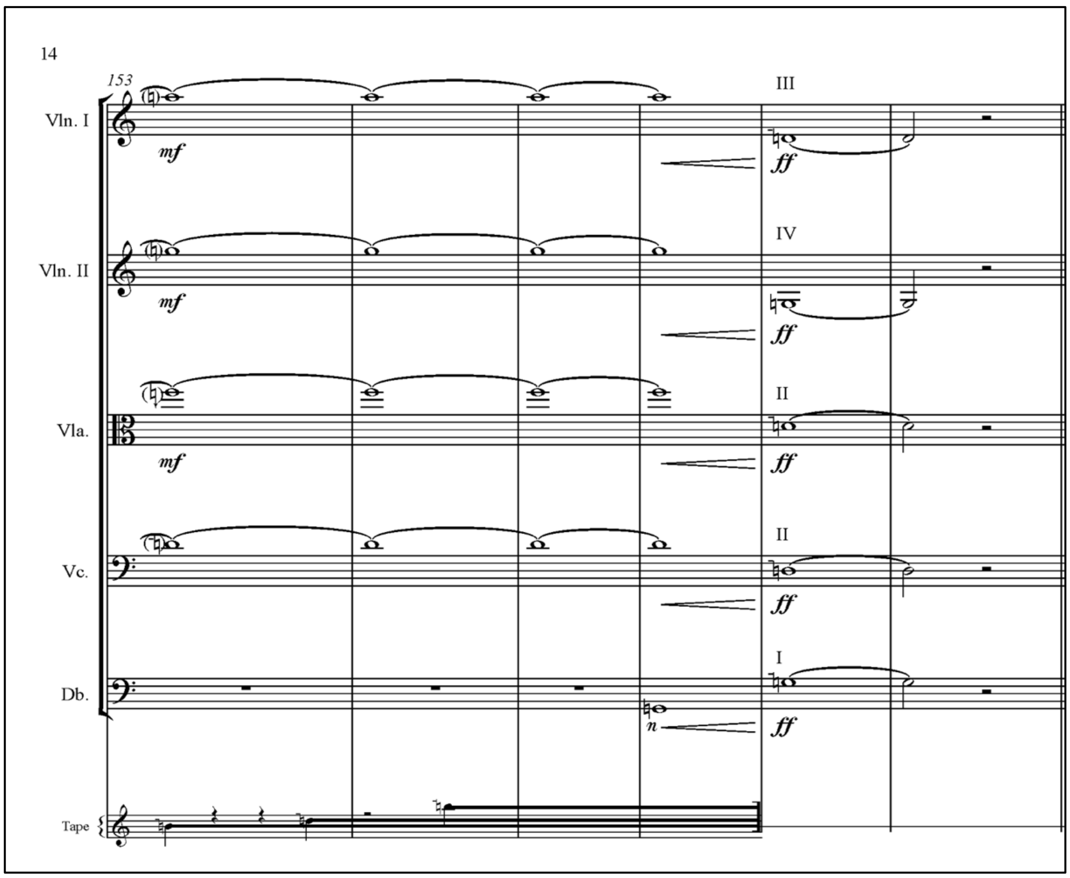

Figure 14. *See Nothing*, mm. 153–158.

The live instruments play stopped pitches that they have matched from the tape track. The tape pitches add to the density and harmonic complexity. Instead of the live instruments staying on one pitch for the crescendo, as is customary at arrival points, they suddenly crescendo to open strings. This is the first time that the live instruments simultaneously play open strings. The range of the chord condenses dramatically, and the tape drops out, creating a dramatic timbral shift. Figure 15 shows the final arrival point, which begins two beats after the previous arrival point ends.

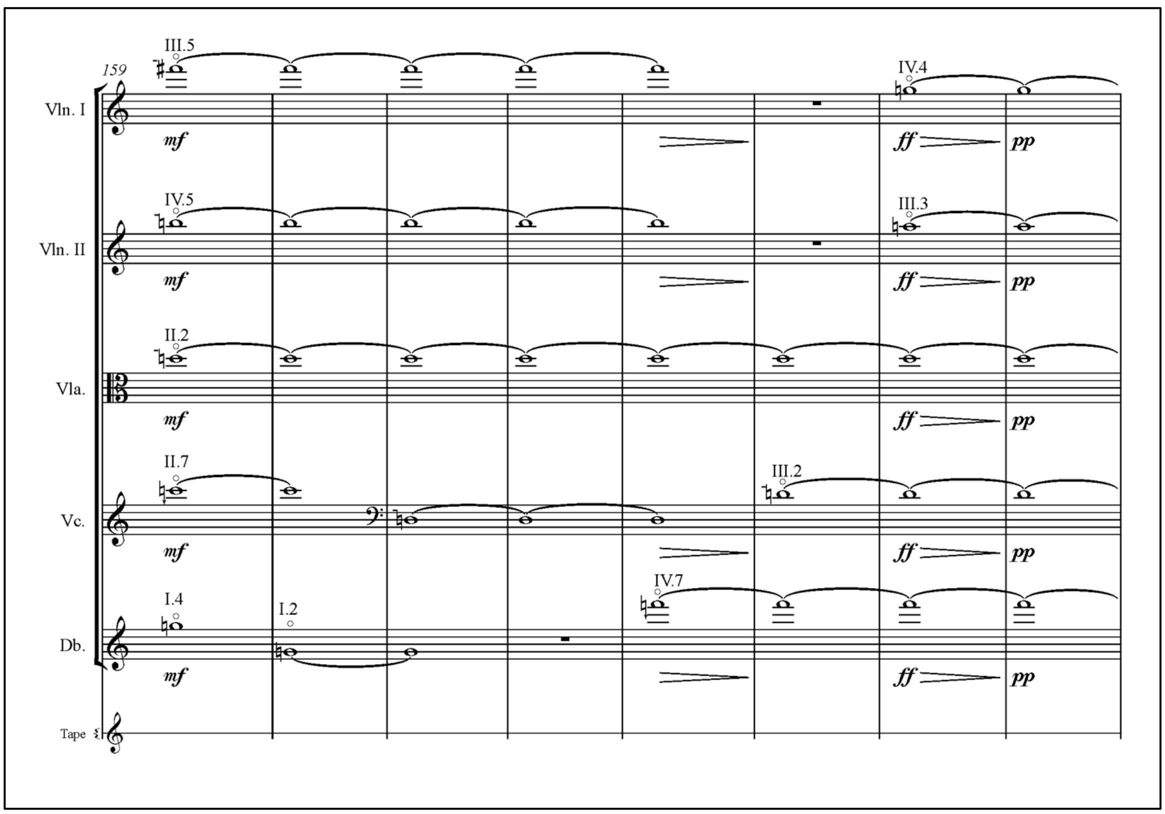

Figure 15. *See Nothing*, mm. 159–167.

This arrival point is marked by the sudden use of harmonics in each of the live instruments. The harmonics allow for the highest pitches of the piece, extending to F#6. The possibilities for natural harmonics on the strings that fit into Chord D means that the instruments can shift between various harmonics, creating a smaller example of the larger structure of the piece: surface level developing harmony that is superficially different, but comes from the same root.

The organization of the static harmony into different chords, as well as the timbral contrast explored throughout the piece, are devices that I have used as a method of shaping the sound of the single harmonic series. These techniques, and the integration of the tape track as a simultaneous tuning device and musical feature, are my personal means of exploring something as recognizable as harmonic series.

CHAPTER V

CONCLUSION

See Nothing relies on the tuning precision required in just intonation, alongside the attention to timbre often present in so-called spectral music. I do not claim to strictly adhere to either musical avenue. I listen to, and study music that emphasizes the harmonic series as a means of learning about various techniques of tuning and organization. My most useful research in approaching this piece has been listening to pieces such as those of Tenney, Haas, and Harrison, both for inspiration, and to ensure that my approach is a fusion of precedents with my own ideas, and not simply derivative of my musical influences.

I developed this method of live-tuning to the tape track in order to be able to explore a wide range of harmonic series pitches with specific tunings. Live-tuning using the tape track has some strengths and weaknesses. The great benefit that I see in this method is the ability for string players to play stopped pitches easily in a non-standard tuning system, without having to memorize new scales. Tuning to the tape track allows the musicians to become familiar with the intervals of the harmonic series, without being expected to tune without reference.

The *scordatura* tunings are not drastically different from normal string tuning. *Scordatura* allows for the flexibility of using harmonics and open strings, which would otherwise have to be avoided. The ability of the performers to find the correct pitches given the string de-tunings is helped by the fact that the live instruments do not have to play many distinct pitches throughout the piece. The notation is specific, but the avoidance of cents deviation is a purposeful tool to encourage the more intuitive practice of tuning to the tape, instead of thinking about how each pitch relates to equal temperament.

The area where this piece could be more practical is the timing. The need for performers to match pitch at a specific time causes metric inflexibility. In future uses of this tuning method, I would like to eliminate the need for a conductor and click track. One possible method of achieving this is to use technology that the performers can control, such as a foot pedal that players can trigger to sound the pitch they need to match. This would allow for much greater metrical freedom.

See Nothing is an experiment on my path of developing practical methods of microtonal tuning, as well as an exploration of the tuning system itself. This project has given me many new ways to think about how technology can be used to help with practical and accurate tuning to non-standard systems. I will continue to develop practical and musical techniques of composing microtonal music.

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APPENDIX A

SCORE OF *SEE NOTHING*

See Nothing

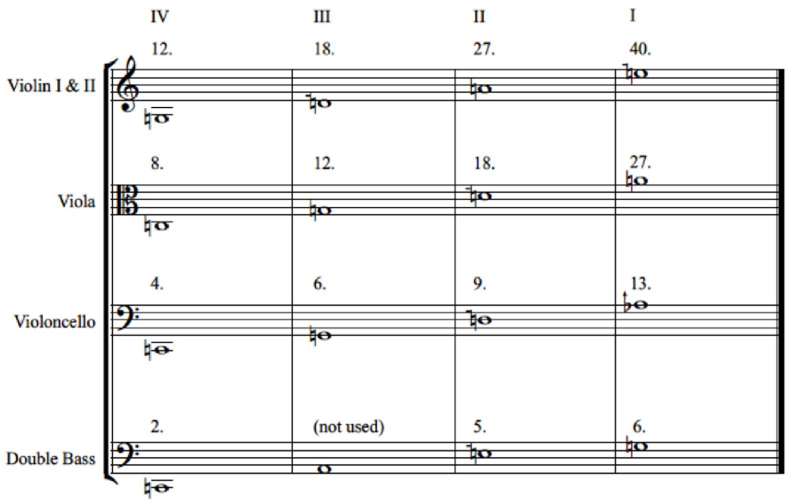
For 2 violins, viola, cello, double bass,
fixed-media track, conductor with click track.

Treya Nash

Performance Notes:

This piece uses alternate tunings based on a harmonic series with a C0 fundamental. The piece relies on a combination of scordatura tuning and pitch matching against a fixed 'tape-track.'

The following shows a re-tuning guide for the strings.



Downloadable pre-recorded pitches to tune the strings accompany this score. All strings should be tuned to these.

Notation:

The following table shows the accidentals used in this piece:

Symbol	Meaning
♭ ♮ ♯	Very close to the equal tempered pitch; either exactly the same or with a very slight difference.
-♭ -♮ -♯	Slightly but noticeably flatter than the equal tempered pitch.
♭ ♮ ♯	Significantly flatter than the equal tempered pitch.
+♭ +♮	Slightly but noticeably sharper than the equal tempered pitch
♭ ♮ ♯	Significantly sharper than the equal tempered pitch

- Accidentals will appear at the start of each measure where they are used, excluding ties.
- Open Strings: Strings I, II, III, and IV will be used above open strings. All other pitches should be played as stopped pitches.
- Harmonics are all natural, and are notated with the sounding pitch, the small circle, and the string number.

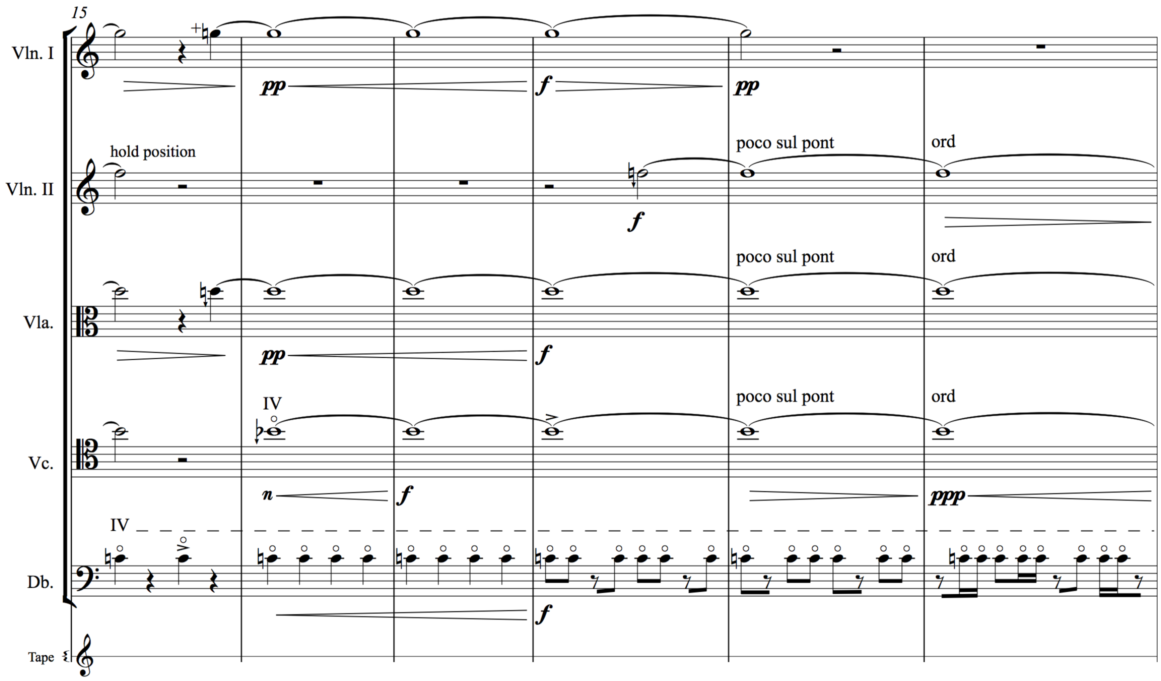
Pitch Matching:

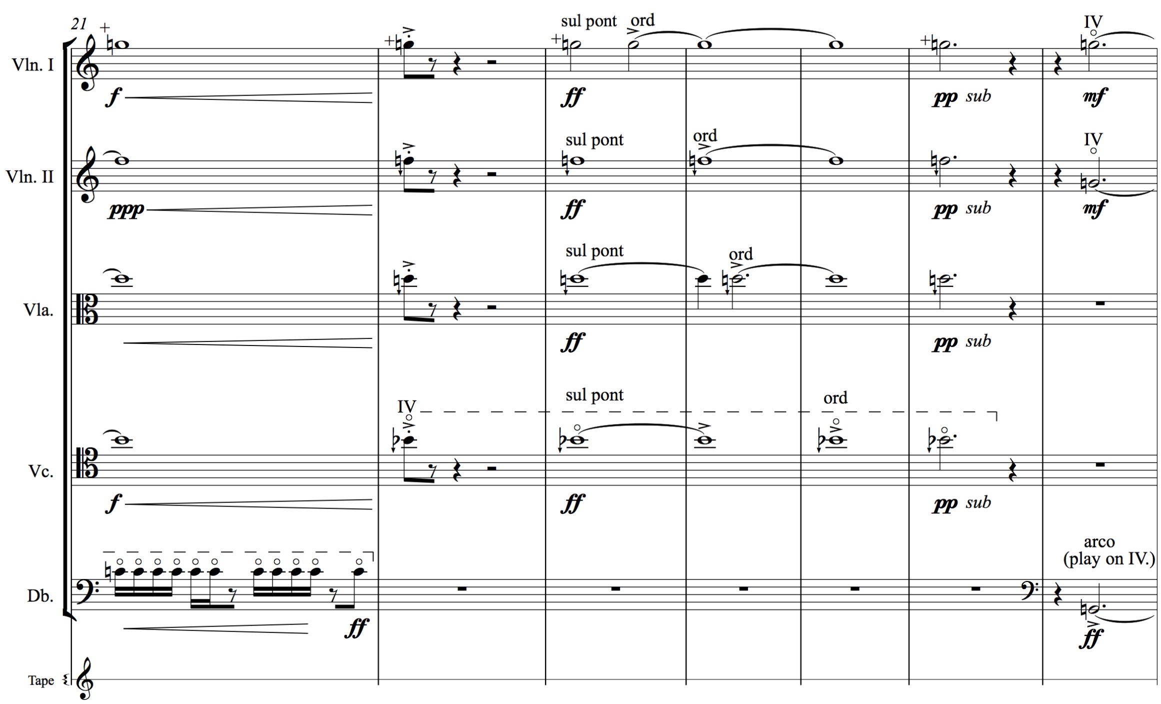
"match tape pitch," later abbreviated to "match," means that the performer should play the pitch they see in the score, and adjust intonation to match the pitch in the tape track. Only one performer tunes to the tape track at a time.

The pitches in the score are written as sounding pitches, disregarding the scordatura (except the double bass, which is written an octave above as per standard practice.)

See Nothing

Treya Nash


15
Vln. I
Vln. II
Vla.
Vc.
Db.
Tape
hold position
poco sul pont
ord
poco sul pont
ord
IV
poco sul pont
ord
IV

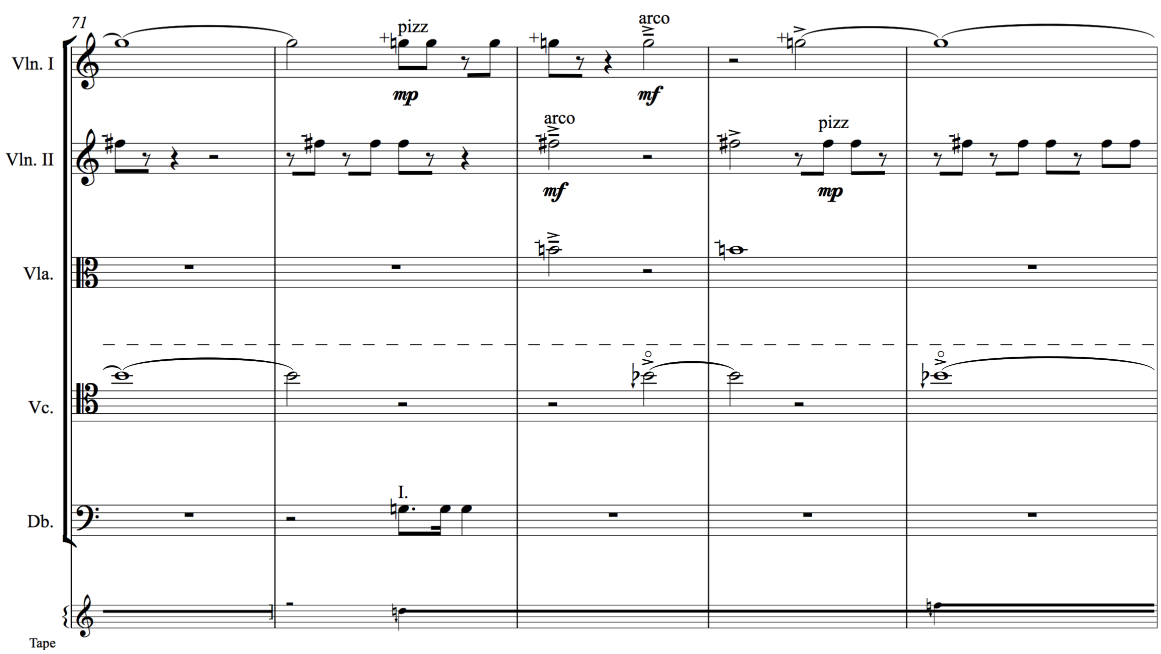

21
Vln. I
Vln. II
Vla.
Vc.
Db.
Tape
sul pont
ord
IV
sul pont
ord
IV
sul pont
ord
IV
sul pont
ord
pp sub
arco
(play on IV.)


28
poco a poco sul pont
ord
Vln. I
pp
match
poco a poco sul pont
ord
Vln. II
n
match
rich tone
Vla.
n
f
pp
match
rich tone
Vc.
n
mf
pp
mf
pp
II.
Db.
ppp
mf
n
mf
pp
(Vla.)
(Vln.I)
Tape
G-harmonic
(Vc.)
To Perc.
f
p
35
match
bold, warm
bring out
sul pont
ord
Vln. I
n
mf
ff
sul pont
ord
Vln. II
f
pp
f
sul pont
ord
Vla.
f
sul pont
ord
Vc.
f
sul pont
ord
Db.
f
(Vln.II)
Tape


42
Vln. I
Vln. II
Vla.
Vc.
Db.
Tape
scratchy attack
scratchy attack
scratchy attack
scratchy attack
scratchy attack
scratchy attack
scratchy attack
scratchy attack
warm tone
warm tone
warm tone
pp
ff
f
p
48
exaggerate accents
exaggerate accents
mf
mp
I.
airy C-drone

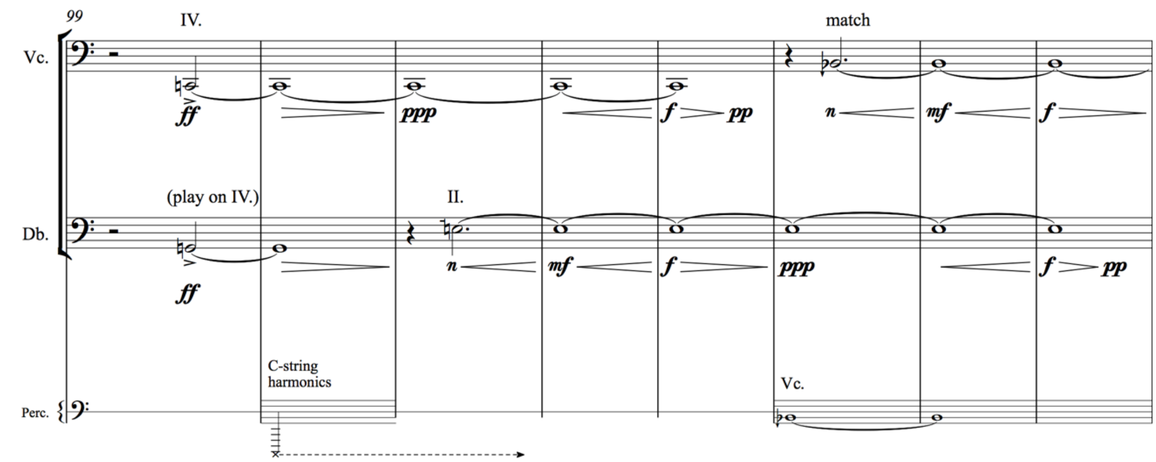

54
Vln. I
Vln. II
Vla.
Vc.
Db.
Tape
match
pizz
mf
p
pp
match
n
IV.
mf
pp
pizz
arco
f
mp
pizz
(Vln.II)
(Vla.)
(airy C-drone continues)
60
Vln. I
Vln. II
Vla.
Vc.
Db.
Tape
arco
pizz
mp
mf
f
IV
I.


66
Vln. I
pizz
mp
arco
mf
Vln. II
pizz
arco
mp
mf
Vla.
mp
mf
Vc.
mp
mf
Db.
I.
Tape
(airy C-drone continues)


71
Vln. I
pizz
mp
arco
mf
Vln. II
arco
mf
pizz
mp
Vla.
Vc.
Db.
I.
Tape


76
Vln. I
Vln. II
arco
pp
f
Vla.
pp
f
Vc.
Db.
arco
match
hold
II.
Tape
(Db.)
(airy C-drone continues)
82
Vln. I
hold
f
Vln. II
ff
f
ff
fade out with tape but
continue quietly
Vla.
ff
f
ff
fade out with tape but
continue quietly
Vc.
IV.7
hold
f
Db.
hold
pizz
II.
f
Tape
airy C-drone ends


87
Vln. I
Vln. II
match
smooth attack
ppp
n
mf
pp
mf
pp
Vla.
match
smooth attack
n
n
mf
pp
Vc.
Db.
mp
mf
ff
(Vln.II)
(Vla.)
Tape
92
smooth attack
pp
ff
fff
smooth attack
IV.
as loud
as possible
p
smooth attack
arco
as loud
as possible
mp
C-string
Overpressure
Perc.


99
IV.
match
Vc.
Db.
(play on IV.)
II.
C-string
harmonics
Perc.
Vc.
ff
ppp
f
pp
n
mf

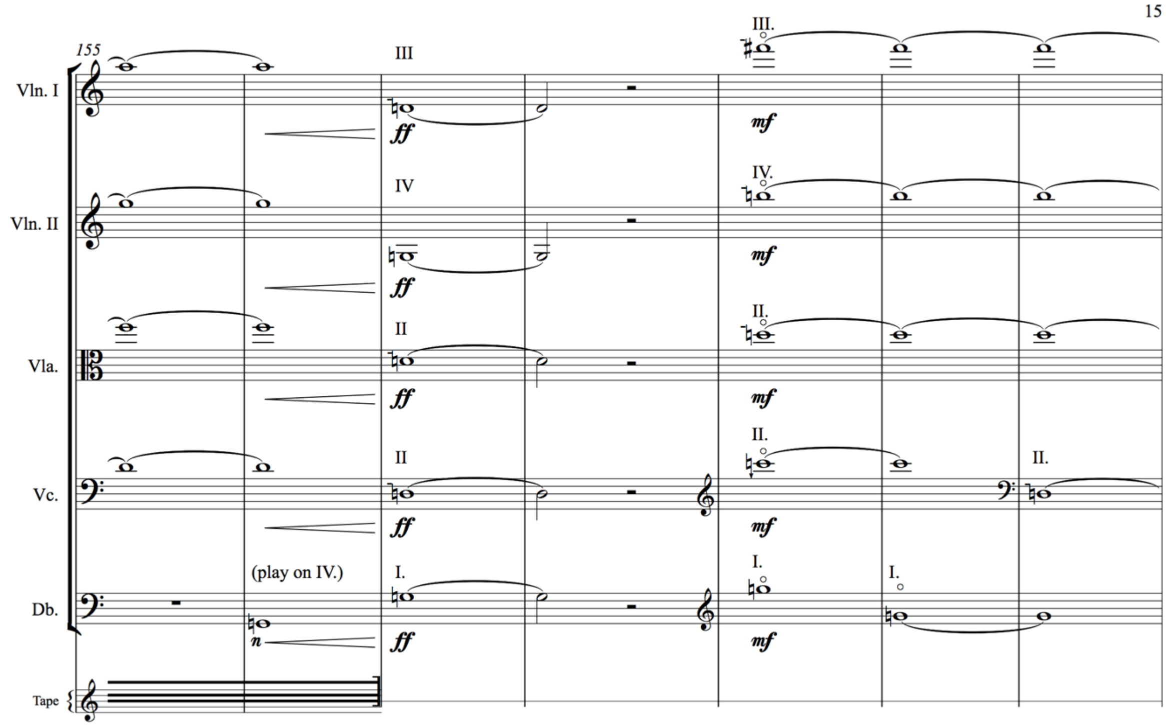

107
Vln. I
Vln. II
Vla.
Vc.
Db.
pizz
p
match
I.
(Db.)
(Vla.)
To Perc.
ppp
f
pp
n
mf

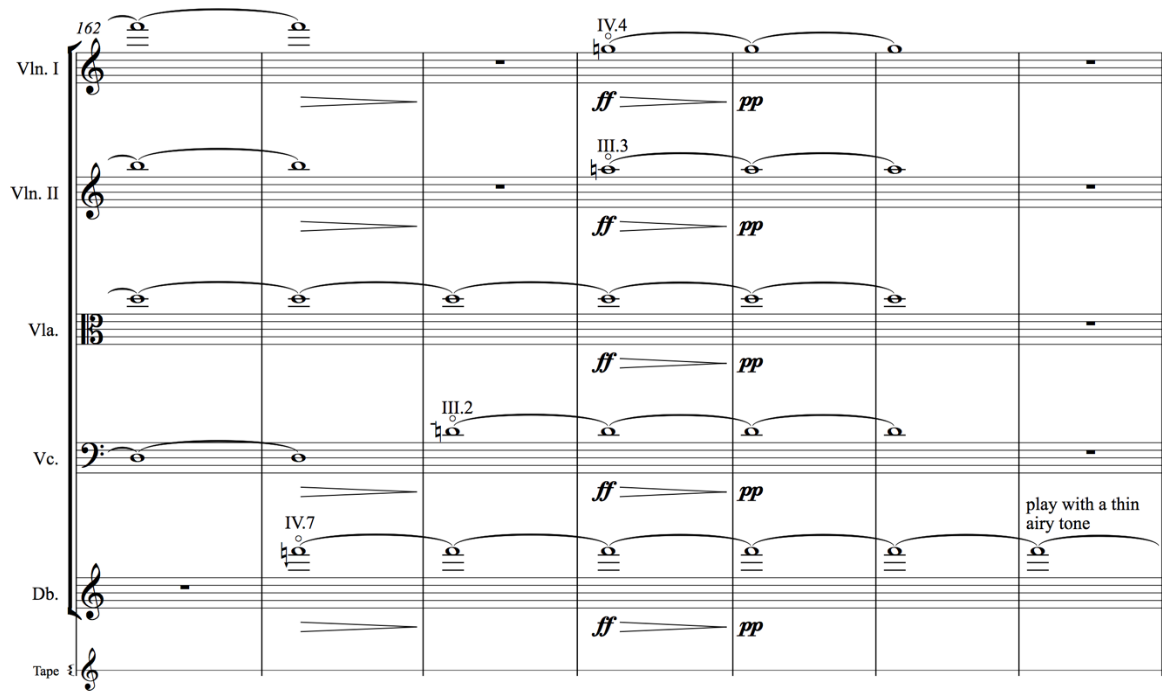

115
Vln. I
Vln. II
Vla.
Vc.
Db.
Tape
pizz
pizz
pizz
pizz
(C-string harmonics continue.)
119
match
arco
match
arco
pizz
(Vln.II)
(Vln.I)


123
Vln. I
Vln. II
Vla.
Vc.
Db.
Tape
pizz
arco
sul pont
ord
arco
sul pont
ord
sul pont
arco
sul pont
ord
sul pont
arco
sul pont
ord
arco
IV.
C-string harmonics end
129
pizz
match
arco
match
ord
pizz
pizz
pizz
(Vln.II)
(Vln.I)

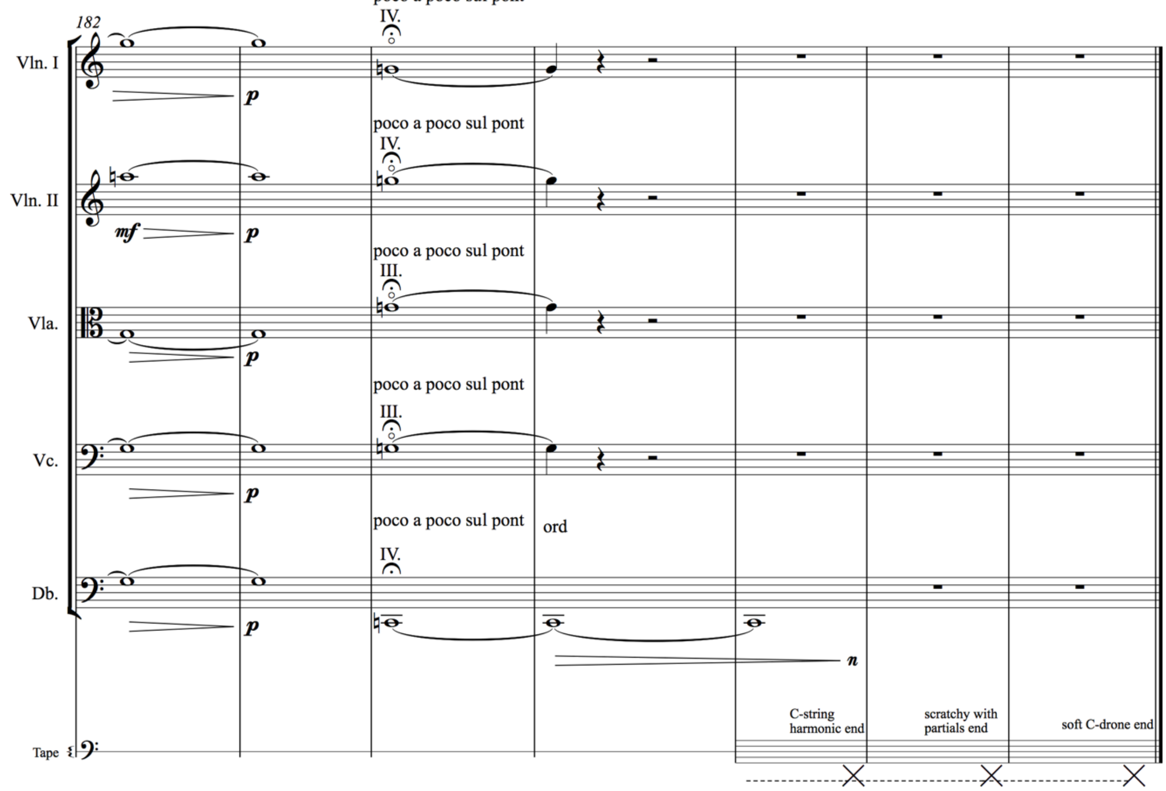

132
Vln. I
Vln. II
Vla.
Vc.
Db.
Tape
pizz
mf
135
arco
pizz
f
fff
IV.
scratchy
with partials
continues until end


141
Vln. I
pp
n
III.
Vln. II
IV.
bright and reverberant
n
mf
ppp
Vla.
pp
n
Vc.
pp
n
IV.
Db.
pp
n
Tape
C-string harmonics
continues until end
148
bright and reverberant
Vln. I
mf
ppp
mf
Vln. II
mf
match
bright and reverberant
Vla.
n
mf
ppp
mf
III.
bright and reverberant
Vc.
n
mf
Db.
(Vla.)
Tape


155
Vln. I
Vln. II
Vla.
Vc.
Db.
Tape
III
IV
II
II
I.
(play on IV.)
III.
IV.
II.
II.
I.
I.
II.
ff
mf
n


162
Vln. I
Vln. II
Vla.
Vc.
Db.
Tape
IV.4
III.3
III.2
IV.7
ff
pp
play with a thin
airy tone


169
match
Vln. I
smooth
attack
III.
Vln. II
II.
Vla.
IV.
Vc.
build to a bright
tone
Db.
(Vln.I)
Tape
176
Vln. I
III.
Vln. II
III.
Vla.
IV.
IV.
III.
Vc.
IV.
I.
Db.
Tape


182
Vln. I
Vln. II
Vla.
Vc.
Db.
Tape
mf
p
n
poco a poco sul pont
IV.
III.
ord
C-string harmonic end
scratchy with partials end
soft C-drone end